Discussion Paper

THE PIPELINE-URBAN ENCROACHMENT PROBLEM: A LAND USE PLANNING PERSPECTIVE

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FOR DISCUSSION ONLY

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THE PIPELINE-URBAN ENCROACHMENT PROBLEM: A LAND USE PLANNING PERSPECTIVE

1. BACKGROUND TO REPORT

1.1 The groundwork for this report was laid in 1978 when the Inter-Agency Planning Branch, Department of Municipal Affairs was requested to review the financial and physical constraints imposed by pipelines on the urban expansion of Drayton Valley. At the time, Drayton Valley was seeking provincial assistance towards relocating the pipelines. However, as further reviews to determine the cost implication of relocation were not undertaken, no firm provincial commitment was subsequently given toward resolving Drayton Valley's problem.

1.2 Further impetus to the writing of this report followed the rupture of the Rimbey pipeline carrying propane in the Mill Woods area of Edmonton on March 2, 1979. The incident resulted in a truck driver being badly burned by the resulting explosion and the evacuation of 19,000 area residents in anticipation of a major disaster. Fortunately, no major disaster occurred, but the seriousness of the incident led to the holding of a public hearing by the Energy Resources Conservation Board (Alberta) (hereafter referred to as the ERCB). In August 1979, the Board published a Decision Report on the incident, which contains a list of tentative recommendations on how similar incidents might be prevented in the future.

1.3 The Board discovered that the rupture was caused by construction-related damages to the pipeline. As third party damage to pipelines has become an increasingly important contributing cause of pipeline failures in urban areas*, the Board

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*Since 1975, no less than 21 breaks or leaks have occurred in Alberta (including both the urban and rural areas) on high vapour pressure (HVP) pipelines carrying liquid propane and other volatile products. Of these 21 failures, eight were the result of third party damage to the pipelines. (ERCB)

requested the Department of Municipal Affairs to jointly explore the feasibility of addressing this problem through the placing of a minimum setback distance between the pipeline and its adjoining developments (Recommendation 6.9 of the Decision Report).

1.4 The Board's findings and recommendations reaffirm the need for a thorough review of the safety implications of encroachment upon pipelines by urban development, or vice versa, from a land use planning perspective. The need is particularly pressing in view of the fact that pipelines are exempt from the provisions of recent federal legislation which seeks to regulate the transport of dangerous goods.

1.5 Since December 1979, the Department of Municipal Affairs through the Inter-Agency Planning Branch has carried out discussions with consultants, planners and staff of the Energy Resources Conservation Board (Alberta), Ontario Hydro, Ontario Energy Board and the National Energy Board, culminating in the writing of this report.

1.6 The timing of this report appears fortuitous. The report was conceived after the occurrence of several major accidents involving the transport of dangerous goods, among which were the Mill Woods Incident and the derailment of a CP train carrying highly toxic material in Mississauga. The net effect of these incidents has been a sudden awareness of the need for proper and safe movement and disposal of dangerous goods, and greater acceptance of both the industry and governments at all levels of the need for legislative controls.

This report will have succeeded if it contributes to a continuing effort to find viable solutions to the problem.

2. PURPOSE, SCOPE AND ORGANIZATION OF REPORT

2.1 Purpose

2.1.1 This report attempts to present a broadbrush picture of the pipeline-urban encroachment problem from a land use planning perspective, to analyse the causes of the problem, and to advance some exploratory ideas on how this problem may be addressed.

2.1.2 The report is written with the aim of stimulating discussion by a broad spectrum of agencies directly or indirectly concerned with pipelines and urban development, whose views will be reflected when the recommendations are revised and made final. These agencies include: the Energy Resources Conservation Board, the Alberta Planning Board, the Department of Municipal Affairs, pipeline operators, developers, planning and subdivision approving authorities, the Housing and Urban Development Association of Canada, and the Urban Development Institute.

2.1.3 It is, therefore, anticipated that a series of formal discussions will be held over the next few months with concerned agencies to determine their views on the problem and on the recommendations contained herein. Out of this consultation will come revised recommendations on which government and private sector actions can be based.

2.2 Scope

2.2.1 In attempting to stimulate discussion among decision-makers concerned with various aspects of the pipeline-urban encroachment problem, it has been necessary to widen the scope of investigation and analysis beyond the points raised in the ERCB Decision Report.

2.2.2 There are two principal reasons for this. One, if the land use planning and development system is to respond to the problem in an adequate manner, a number of actions will be required from a broad range of actors. An analysis of how intended Provincial initiatives would affect them is a prerequisite to successful problem resolution.

Two, the complexity of relationships involved in the process of planning, building and operating a pipeline; and in the process of urban development, necessitate a somewhat detailed presentation if the main elements are to be seen clearly. Also, it is apparent that planners as well as the general public have suffered from a dearth of information on the subject which perhaps should, to some extent, be overcome by this report.

2.2.3 In so doing, the scope of the report goes beyond what was originally recommended in the Decision Report on the Mill Woods Incident, in several respects. First, rather than single out the use of a minimum setback distance as a means of controlling potential third party damage to the pipeline after the pipeline-urban encroachment problem has developed and become deeply entrenched, the report takes a broader view of how the encroachment problem might be dealt with in all phases involving the planning and installing of a pipeline project, and the subsequent development of its adjoining areas. In this way the safety of the pipeline will no longer be considered in isolation from the overall land use planning process, or only given the attention after the encroachment problem has become a fact.

2.2.4 The report views the imposition of minimum setback conditions as only one among a number of feasible land use planning mechanisms for addressing the pipeline-urban encroachment problem. It concludes that this option should be exercised selectively, and applied to only those cases where there is a demonstrated need for a buffer zone (e.g. for pipelines carrying hazardous products passing through densely populated areas), especially in view of the cost implications that setbacks may have on land development and the difficulty of arriving at a minimum separation distance that is unequivocably accepted by every party involved.

2.2.5 While most of the recommendations in the Decision Report appear to relate only to pipelines carrying hazardous products such as liquid propane, butane, condensate and so on, this report has not restricted its scope of discussion to only hazardous products pipelines. In opting for a general treatment of the subject matter, the report recognizes the need to distinguish the various categories of pipelines on the basis of the products they carry, and the level and nature of impact that may be incurred in the event of a failure.

2.3 Organization of the Report

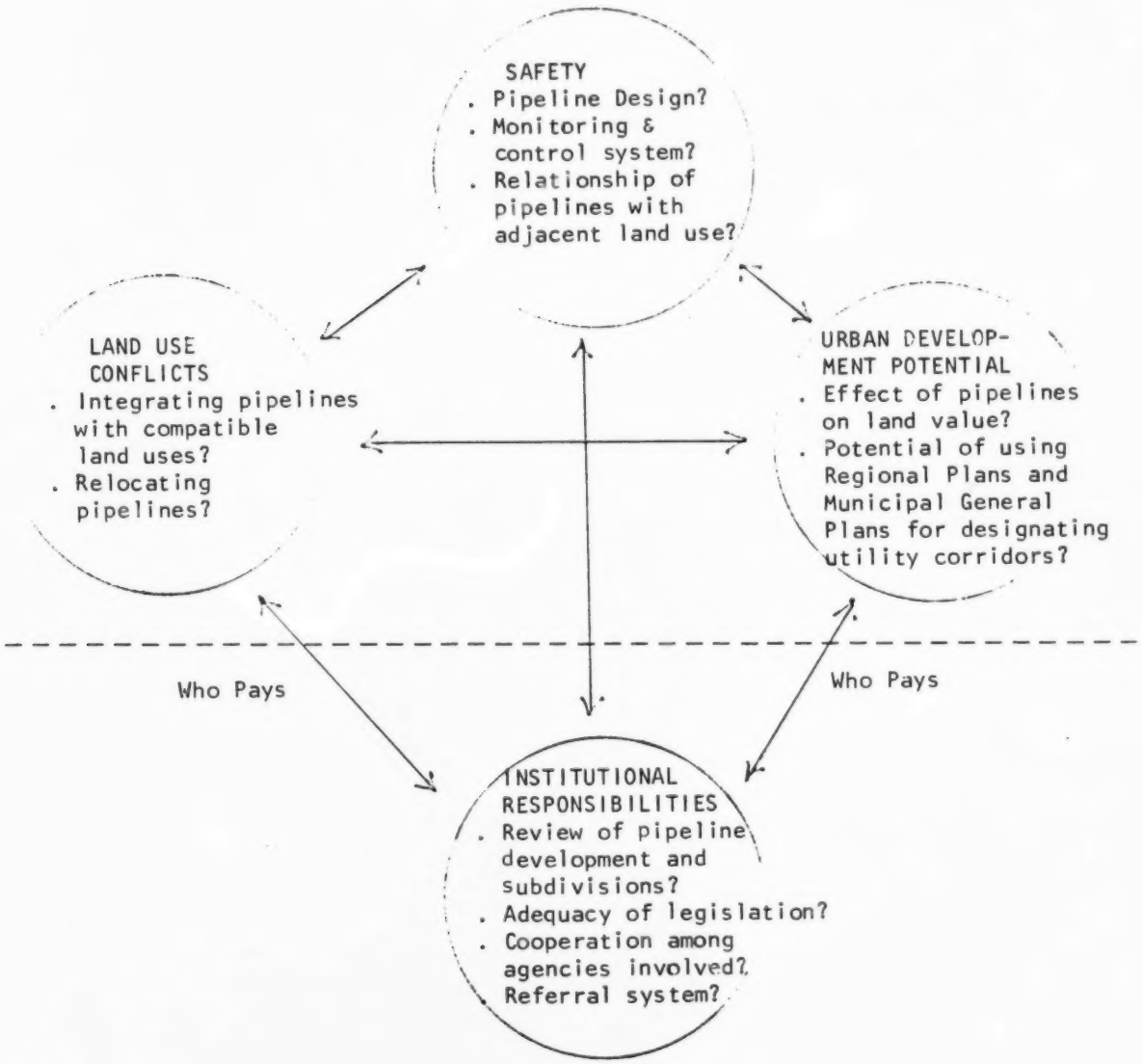
2.3.1 The report is composed of 7 sections. The first two sections explain how the Department of Municipal Affairs has become involved in reviewing the pipeline-urban encroachment issue, and the scope and purpose of the report. An exposition of the pipeline-urban encroachment problem is then presented in Section 3, together with a general description of the magnitude of the problem and the safety implications of locating pipelines within residential neighbourhoods.

2.3.2 Section 4 explains in detail the various contributing factors to the encroachment problem, highlighting the shortcomings of the existing practices associated with selecting and designating pipeline rights-of-way; the lack of awareness of pipeline safety implications; the existence of inadequacies in legislation and the lack of communication among the authorities having a role in supervising or regulating the pipeline and land development. (The description relates primarily to the Alberta experience and only peripherally to experiences elsewhere in Canada).

2.3.3 By depicting and analysing the causes of the encroachment problem, the report also directly points up the potential areas for improvement. Section 5 examines in some detail how the existing land use planning instruments can be utilized in a general way to deal with the problem, and then briefly indicates the major recommendations, agency by agency, including the private sector.

2.3.4 Section 6 and 7 focus in on the governmental agencies, since they have an important leadership role to play, and present detailed recommendations in the form of a *commitment package*. Essentially, the commitment package groups the recommendations into a simple schema which enables the readers and users of this report to identify clearly what actions can or should be initiated immediately; which actions should be delayed; what further explorations should be made; who should be responsible for the implementations of actions proposed, and so on.

Figure 1: THE SHAPE OF THE ENCROACHMENT PROBLEM


SAFETY
. Pipeline Design?
. Monitoring & control system?
. Relationship of pipelines with adjacent land use?
LAND USE CONFLICTS
. Integrating pipelines with compatible land uses?
. Relocating pipelines?
URBAN DEVELOPMENT POTENTIAL
. Effect of pipelines on land value?
. Potential of using Regional Plans and Municipal General Plans for designating utility corridors?
Who Pays
Who Pays
INSTITUTIONAL RESPONSIBILITIES
. Review of pipeline development and subdivisions?
. Adequacy of legislation?
. Cooperation among agencies involved?
. Referral system?

3. EXPOSITION OF THE PIPELINE-URBAN ENCROACHMENT PROBLEM

3.1. The Problem Focus and Problem Characteristics

3.1.1 The pipeline-urban encroachment problem appears to centre around the relationships among three inter-related factors, namely; safety, urban development pressure and land use conflicts (Figure 1). Over time, the workings of these three factors determine the spatial relationships of a pipeline to its surrounding areas. The interplay of these factors is governed by the institutional responsibilities, the attitudes, and practices of various agencies which have a role in regulating pipelines and urban development.

3.1.2 The problem is characterized by the location of a pipeline in proximity to densely populated residential neighbourhoods; by the juxtaposition of a pipeline* and residential buildings; and by the lack of recognition of the safety implications of such a spatial arrangement. Further, the problem is manifested in the alignment of pipeline systems in or near urban areas, resulting in some cases in the fragmentation of potentially developable lands, or the uneconomic and inefficient development of lands affected by the system.

3.1.3 At the heart of the problem are therefore two principal concerns: safety and cost of development. In the following sub-sections, only the former concern will be addressed; the latter will be treated in conjunction with other issues in Section 4.

3.2 Safety Implications of Pipelines

Generally speaking, not many people are aware of the existence of pipelines, especially since they are underground and out of sight. Typically, a public outcry regarding the safety implications of a pipeline emerges only after a relatively major pipeline accident has occurred.

3.2.2 What is also generally not understood or appreciated by the public, however, is that safety is a comparative concept based upon the amount of risk involved. Relative to other conventional modes of transport (e.g. trucks, railways), the pipeline is generally regarded as the safest and most economical means of moving oil and gas over a long distance.

3.3 Safety Provisions in CSA Codes and Legislation

3.3.1 Pipelines are stringently regulated by an array of codes and standards designed to ensure public safety. The ERCB, through the Pipeline Act, 1975 has control over many aspects relating to the design, routing, construction and operation of a pipeline and the products it carries. The provisions of the Act adhere closely to the standards recommended by the Canadian Standards Association (CSA) -- being Z183 for oil pipeline systems and Z184 for gas pipeline systems.

3.3.2 A number of provisions have significant land use implications. For example:

The Act provides for crossing agreements between two intersecting pipelines as means of controlling potential third party damage to the pipelines. (Such arrangements do not, however, apply to crossings by other utility lines);

The pipeline operator is authorized to exercise control over surface operations conducted on or near the pipeline right-of-way (ROW) through easement agreements; and

The ERCB may direct the relocation of a pipeline and specify who should be responsible for the cost of such relocation.

3.3.3 The relationship between the pipeline and its external environment are also accounted for in the Pipeline Act, 1975, and Regulations, (which provide for referral conditions and procedures), through reference to the CSA codes.

Under Z184 of the CSA codes, provision is made for the consideration of population density in the design of gas pipeline systems. For example, four design factors are employed in making adjustments to the maximum operating pressure and the nominal wall thickness permitted for steel pipelines based on the following class locations.

Class Location	Density of Development	Design Factor*
1	Rural Area	0.72
2	Urban Fringe	0.60
3	Suburban/Urban	0.50
4	Urban Core	0.40

A similar, but modified two-zone system is used in Z183 for high vapour pressure pipelines.

3.3.4 It is significant that the enabling legislation and CSA standards acknowledge the relationships between urban development and the pipeline. Section 6.3 of Z184 states that:

> "When classifying locations due consideration shall be given to the possibility of future development of the area. If at the time of planning a new pipeline such future development appears to be sufficient to change the location class, this shall be taken into consideration in the design and testing of the proposed pipeline."

3.3.5 Another rather unique safety provision, introduced by Alberta, is the stipulation of minimum distance requirements separating new sour gas facilities from residential and other developments. This is done through the Subdivision Regulation under the Planning Act, 1977.

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* In practical terms, this means that for a steel pipeline system located in the rural area (Class Location 1), it is allowed to operate at a pressure that will only stress the pipe to 72% of its specified minimum yield strength; under Z184 and for a similar pipeline in the urban core, only up to 40% of its specified minimum yield strength.

3.3.6 The legislation and CSA codes also recognize the need for additional safeguards for ensuring public safety at crossings by roads and railways through warning signs, reinforcement of the pipeline, etc.

3.4 Magnitude of Pipeline Failures

3.4.1 From the above, it can be stated that under normal operating conditions, the design standards as provided for in the CSA codes (Z184 and Z183) and other pipeline legislation are generally considered to be adequate for public safety. However, in spite of the best design and construction and frequent inspection and regular monitoring, a pipeline system may still fail because of corrosion, mechanical problems or human error. In recent years, while new technology has improved the performance of the pipeline and resolved or ameliorated some of the pipeline design and engineering problems, third party damage remains one of the most significant contributing factors in the case of pipeline accidents.

3.4.2 Table I reveals that between 1975 and 1979, human error and equipment damage together accounted for 494 of the 2605 pipeline failures occuring in Alberta, or 19% of the total failures. Conceivably, with increased urban development and further expansion in the number of pipeline systems in the next few decades, the potential for third party damage to pipelines will also increase, unless some timely measures are introduced to address this problem.

3.5 Nature of the Hazard

3.5.1 The low risk level of pipeline failures may belie the potential adverse impacts that even a single incident may inflict on the life and property of the neighbouring population. In this regard, a general distinction can be made between the types and varying degrees of impact brought about by pipelines carrying different products and operating under different pressures. For example:

a) Failures of crude oil pipelines produce mainly environmental pollution and sometimes health problems, but seldom result in an explosion or fire;

Table I NUMBER AND PERCENTAGE DISTRIBUTION OF PIPELINE FAILURES,

BY REASON, FOR ALBERTA 1975-79

REASON	1975		1976		1977		1978		1979		CUMULATIVE 1975-79	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Error & Equipment Damage	93	17	88	18	95	18	83	17	135	25	494	19
Metal Failure	87	16	73	14	65	12	94	19	69	13	388	15
Corrosion Failure	250	45	258	51	286	54	220	45	228	43	1242	48
Equipment Failure	55	10	39	8	34	6	28	6	33	6	189	7
Other	64	12	46	9	53	10	62	13	67	13	292	11
TOTAL	549	100	504	100	533	100	487	100	532	100	2605	100

NOTES:

1) Error and Equipment Damage includes, Operator Error, Construction Damage, Damage by Others, Earth Movement

2) Metal Failure includes, Pipe Failure, Seam Rupture, Weld Failure

3) Corrosion Failure includes, Internal, External, and Corrosion at Girth or Fillet Weld

4) Equipment Failure includes, Valve or Fitting Failure, Overpressure, Failure at an Installation

5) Other Failure includes, Joint, Miscellaneous and Unknown Failures

Source: ENERGY RESOURCES CONSERVATION BOARD, ALBERTA

b) Failure of natural gas lines cause the release of gas up into the atmosphere (since the gas is lighter than air) and may cause an explosion or fire. If, however, the pipeline is operating under very high pressure, the velocity of the escaping gas may rip the pipeline apart over a distance of up to two thousand feet, often causing ignition through friction or exothermic effects;

c) Release of sour gas because of a pipeline failure can present serious health hazards. As the gas is extremely toxic, exposure to relatively low concentrations of the H_2S gas may be fatal;*

d) Some pipelines may carry chemicals which are toxic (e.g. ammonia). Failure of such lines may create serious environmental pollution and health hazards.

e) Failure of high vapour pressure lines containing liquids such as propane, butane ethylene can cause a major disaster. The escaped vapour, being heavier than air, can accumulate in low lying areas and infiltrate sewers and other underground installations, and be ignited to cause an explosion and a fire.

3.5.2 The Mill Woods Incident is perhaps most illustrative of the potential hazards that can be caused by the rupture of a pipeline of the last category. The Decision Report on the Incident implies that is was out of sheer luck that a major tragedy was averted; that had it not been for the early discovery of the rupture, more propane gas would have dispersed over a larger area and migrated into the sewers, creating the potential for a major explosion, with widespread destruction.

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* In view of the toxicity of the sour gas, provisions have been introduced in the Subdivision Regulation for the separation of new sour gas facilities from residential and other developments.

4. GENESIS OF THE ENCROACHMENT PROBLEM

4.1 In view of the possible adverse impact of the pipeline on its adjoining areas, the question will inevitably arise as to why some densely populated areas and buildings designed for high density (e.g. schools, hospitals, community halls) have been permitted to be located on or close to pipelines carrying hazardous products. For example, it has been said that in a city such as Edmonton, where pipelines abound, it is not uncommon to find that the backyard of a house forms part of a pipeline easement, and that the owner is either totally unaware of its existence or perhaps unreasonably concerned about the consequences of a pipeline failure at some future date.

4.2 A convenient way to develop an answer to the above question is to examine the various stages in which a pipeline is planned for and installed, and the adjoining areas developed in response to the pressure of urbanization. A stage-by-stage scenario of how the problem develops is presented below (Figure 2).

4.3 The Planning Stage: Application for Routing and Installation of a Pipeline

4.3.1 To set the scene, let us assume that initially when a pipeline is planned, it is to be located in a rural area, largely on account of economics of installing the pipeline, safety, ease and cost of acquisition of land for the ROW, and other factors such as proximity to refinery facilities.

4.3.2 Frequently, it is during this planning stage, when the pipeline route is being selected and the engineering requirements are being assessed, that the potential problem of urban encroachment at a later date are sometimes being overlooked.* A number of problems may occur during this critical period.

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*In many cases, however, some safeguard against this problem is provided by the landowners themselves. Being aware of the negative effect that the resultant fragmentation of land may have on the value of his land and its development potential, a landowner will, no doubt, try to negotiate with the pipeline operator to keep fragmentation of land to a minimum.

Figure 2

THE "PROBLEM MATRIX": THE DEVELOPMENT OF THE PIPELINE-URBAN ENCROACHMENT PROBLEM

Time Scale →

Spatial Scale ↑

	PLANNING STAGE (Routing & Design of Pipeline)	PIPELINE INSTALLATION/ PRE-URBAN DEVELOPMENT STAGE	URBAN DEVELOPMENT STAGE
REGIONAL & INTER-MUNICIPAL LEVEL	. Location of pipeline in areas subject to urbanization pressures . Haphazard alignment of pipeline ROWs fragment lands . Inadequate consideration given to joint use of ROWs	. Inadequate warning signs along pipeline ROWs; public unaware of existence of pipelines . Damage to pipeline due to inadequate supervision during installation	. No incentive to relocate pipeline into common pipeline ROWs
MUNICIPAL & COMMUNITY LEVEL	. Municipality not generally involved in planning and approval of pipeline projects . Municipality lacking knowledge about safety implications of pipeline and impact of future land use, hence failure to make advance provisions for integration of pipeline with future urban development	. Municipalities not involved in surveillance and control over construction related activities on or near pipeline ROWs . Reliance on landholders of pipeline easement for enforcement	. Municipality requires developer to design around pipeline, dedicate ROW or adopt other measures, thereby increasing the cost of development . Municipality too permissive toward development of land abutting pipeline ROW, thereby increasing potential risk of third party damage to pipelines
SITE SPECIFIC LEVEL	. Pipeline company does not insert adequate enforcement and liability clauses in easement and crossing agreements in areas not earmarked for urban development	. Rural landholders may rupture pipeline during course of farm operations, construction, etc.	. Homeowners, developers may puncture pipeline because of lack of knowledge of safety implications or laxity in control over surface activities

4.3.3 First, the pipeline company and the regulatory agency (i.e. ERCB) may overlook the need to formally consult the appropriate rural municipalities and the urban communities close to the ROW in determining where to locate the pipeline, as this is not required under the existing pipeling legislation of Alberta.* Consequently, the pipeline may be routed through an area which will subsequently be subject to urban development.

4.3.4 Second, in spite of a growing appreciation of the potential savings and other benefits that may be gained from consolidating the new pipeline with other existing pipelines into joint ROW's, or aligning it along road allowances or quarter-section lines, the company may advocate the use of the least distance, one-ROW-for-one pipeline approach as a guiding principle for selecting and acquiring pipeline ROW's, on grounds of economy and ease of administration. In so doing, the company together with other pipeline operators contributes, unwittingly, to the fragmentation of land and jeopardizes the development potential of lands on either side of the pipeline.

4.3.5 Third, the company may underestimate the future impact of the pipeline, in terms of safety, on the adjoining areas which are to be developed for residential or other intensive urban uses. This applies in particular to rural areas for which little or no forward planning has been undertaken to determine their future use or development potentials. As a result, the company may not introduce more stringent measures in the original design and engineering requirements of the pipeline (e.g. deep burial of the pipeline, use of thicker and stronger pipes, reinforcement of pipeline in places where crossing by roads and utility lines are likely to occur, installation of more sensitive monitoring devices, etc.). Or the

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*Nevertheless, the ERCB does, as an established practice, set up public hearings into controversial or large scale projects. Since few projects fall within these categories, it is estimated that on the average, only about 30 proposals out of some 3,000 applications processed by the ERCB annually, are subjected to a public hearing process.

company may not feel the need to involve the affected municipalities in the preparation of an emergency contingency plan for the pipeline, since the law does not appear to require that this be done in consultation with local governments affected by the pipeline except for sour gas pipelines. As a result, the municipalities may not be aware of the safety implications of the pipeline at all before a break actually occurs.

4.3.6 Fourth, the company may also fail to effect adequate control over access and potential third party damage, to the pipeline through inspection and monitoring procedures and by the inclusion of appropriate liability and enforcement clauses in the crossing agreements with other pipelines, roads and utility lines, and in the easement agreement. This may have the effect of placing the responsibility for enforcement on the land owner, who may have little knowledge of the safety implications of allowing public access to, or surface activities to occur on or near, the pipeline ROW.

4.3.7 Fifth, the above practices may have another undesirable longer term effect on the adjoining municipalities (especially the urban community) which are only in a position to passively respond to the impact of the pipeline, rather than anticipate and make advance provisions for the integration of the pipeline with future urban development activities. The lack of municipal and citizen involvement may well encourage apathy and a lack of concern for the safety implications of the pipelines among local elected officials, bureaucrats and the general public. Consequently, little or no effort may be made by these bodies or by individuals to monitor and control future construction activities on or near the pipeline ROW.

The local people are ultimately well suited to ensure the integrity of the pipeline on a day-to-day basis, since they are generally the first to know of activities which may impinge upon it. Were they given the knowledge of what activities may harm the integrity of a pipeline, they would be able to act in the role of an ad hoc monitoring agent, supplementing the monitoring activities of the pipeline company's own staff.

4.4 Pipeline Installation/Pre-urban Development Stage

4.4.1 Most problems that may be encountered at this stage have something to do with whether or not proper inspection procedures and adequate surveillance are carried out to ensure the integrity of the pipeline.

4.4.2 The pipeline may suffer damage during the installation period if adequate safety measures are not provided for crossings between the pipeline and roads and utilities, or if adequate supervision is not carried out in the backfilling of the ditch and for the reclamation of the affected areas. Even slight damage incurred at this stage may have serious consequences as it will enhance the potential risk of a rupture of the pipeline at a later date.

4.4.3 Damage to the pipeline may also occur after the line has been installed. For example, the public may not be adequately warned of the existence of the pipeline underground because few or no signs are placed conspicously along the pipeline ROW*, and the landowner may not understand the safety implications of the pipelines. Consequently, surface activities may be allowed to take place on the ROW without much in the way of precautionary measures. It would therefore appear useful for the pipeline company to begin involving municipal officials and the pipeline easement holder in the control over such activities, as the company alone may not be able to exercise enough surveillance or control each and every surface activity on the pipeline ROW.

4.5 Urban Development Stage

4.5.1 With the commencement of subdivision and development of land in areas adjacent to the pipeline, in response to population growth and the demand for land for housing and various other urban purposes, some of the inherent problems mentioned earlier begin to show up.

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*This problem has now been rectified to a large extent by the ERCB introducing amendments to the Pipeline Act, requiring warning signs to be placed on every road crossing.

4.5.2 Confronted with the difficult task of how best to accommodate the pipeline with minimum land use conflict, a municipality may respond in two entirely different ways. One, if it is concerned about public safety, vis-a-vis potential third party damage to the pipeline, it will probably insist that the developer provide adequate separation distance between the pipeline and the adjoining developments or develop a subdivision scheme that accommodates the constraints imposed by the pipeline (e.g. combining the pipeline ROW with other low density uses, such as parks, pedestrian walkways and bicycle paths). Or the municipality may itself want to control public access to and surface activities on the pipeline ROW by requiring the developer to fence off the ROW and perhaps dedicate it to the municipality.* Frequently, these are expensive and politically unpopular propositions, as they may have the effect of inflating the cost of development, which is eventually passed on to the homeowner and the taxpayer.

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*The Planning Act, 1977, specifically exempts pipelines from its provisions which does not appear to have been the case with earlier Acts. There is concern as to whether a municipality can acquire pipeline ROW's through reserve dedication provisions under the Act, as well as whether a subdivision approving authority can insist upon the imposition of minimum setback conditions on account of the existence of a pipeline. Other Provinces suffer from a lack of policy in this regard, too. For example, the Province of Ontario does not have clear guidelines on minimum setback requirements or planning design standards for developments abutting pipelines. In the absence of such guidelines the City of Brampton has introduced its own standards by imposing a 50 foot setback between occupied buildings and the Trans-Canada pipeline ROW, and the dedication of a 15-foot buffer zone to the City. Discussion with the City's planning officials indicates that the development industry there is unlikely to raise issue with these requirements (there are only a few local developers affected, and they represent large companies which have enough appreciation for the issues involved).
In Alberta, because of the lack of clear authority, some subdivision approving authorities have continued with their past practice of designating pipeline ROWs as environmental reserve or public utility parcels. However, as pointed out in a recent proposal of the Planning Department, City of Edmonton,on this subject, there are legal problems involved; the continuation of such practice may require amendments to The Planning Act, 1977.

4.5.3 If, however, the municipality is unaware of or unconcerned about the safety implications of the pipeline, it may allow developments to encroach on the pipeline, or even allow a pipeline ROW to run underneath the backyards of adjoining houses.

A municipality which permits these practices is unlikely to recognize the need to exercise proper supervision and care to ensure the integrity of the pipeline when the houses are being constructed, nor is it likely to warn the prospective homeowner of the potential risks of constructing a garage in a backyard underlain by a pipeline.

4.6 Some Conclusions about the Encroachment Problem

4.6.1 The purpose of the foregoing discussion is to show that the problem of urban development encroaching upon a pipeline is frequently the result of an evolutionary process. This process has both a spatial dimension, as well as a time dimension, with aspects of the problem developing at a regional scale, the level of a single community, and on a site basis; and occurring at the planning stage of a pipeline, during installation, and afterwards, when urban development encroaches upon the pipeline. Problems occurring earlier in the process or at a "higher" spatial scale frequently create problems for later phases or for events occurring at a "lower" (municipal or site) level.

4.6.2 It must be emphasized, however, that the problems identified in the stage-by-stage scenario presented above are not hypothetical examples; they abound in reality and affect the lives and property of those individuals and agencies who have to live with them. Discussions with officials of the ERCB and planning agencies inside and outside Alberta, throughout the preparation of this report, confirm that:

1) a significant number of pipelines ROW's in Alberta are aligned in such a way as to fragment land, or are being gradually enveloped by urban development. (Figure 3);

2) there is inadequate enforcement over the pipeline easement by the easement holder, the pipeline operator, and the municipality concerned*;

3) municipalities are generally not involved in decisions over the planning and installation of pipelines;

4) there is inadequate recognition given to the need for imaginative land use planning and design so as to integrate pipelines safely and usefully into the urban fabric;

5) loopholes exist in the pipeline and planning legislation to limit the ability of the regulatory authorities to deal with the problem of third party damage to the pipeline. However, it is now learned steps are being taken by ERCB to rectify this problem through amending the legislation; and finally,

6) the public generally lacks understanding and/or information on the safety implications of pipelines.**

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* It should be noted, however, that since the occurrence of the Mill Woods Incident, there has been greater recognition for the need to adopt preventive measures to reduce potential third party damage to pipelines. The City of Edmonton, for example, has taken steps to tighten municipal procedures for inspection and monitoring of construction activities occurring on or near pipelines after the incident. It is not known, however, whether similar attempts have been made by other municipalities, or what cost implications exist for the regulatory agencies and for the developers and contractors.

**This problem exists, notwithstanding the fact that information on the location and technical specifications of all the 85,000 miles of pipeline in Alberta are kept by the ERCB in microfilm form (called aperture cards), which are available to the public upon request. This is because the user of the information may not know how to interpret the data. In a seminar attended by staff of the Pipeline Department, ERCB and planners from across the Province in January, 1980 the point was raised that "often planners do not understand fully from the ERCB's comments on a subdivision application what safety provisions and emergency measures have been adopted and agreed upon for an adjacent pipeline". Some planners have made the attempt to work with pipeline companies on establishing acceptable setbacks, but again such efforts have often been hampered by the reluctance of some companies to cooperate, and by the Alberta Planning Board over-ruling, from time to time, any setback requirement imposed by planning agencies as a condition for approval of subdivision.

4.6.3 In order to address these problems, a concerted effort is required by all those agencies involved in making decisions on the planning and installation of pipelines and on land development.

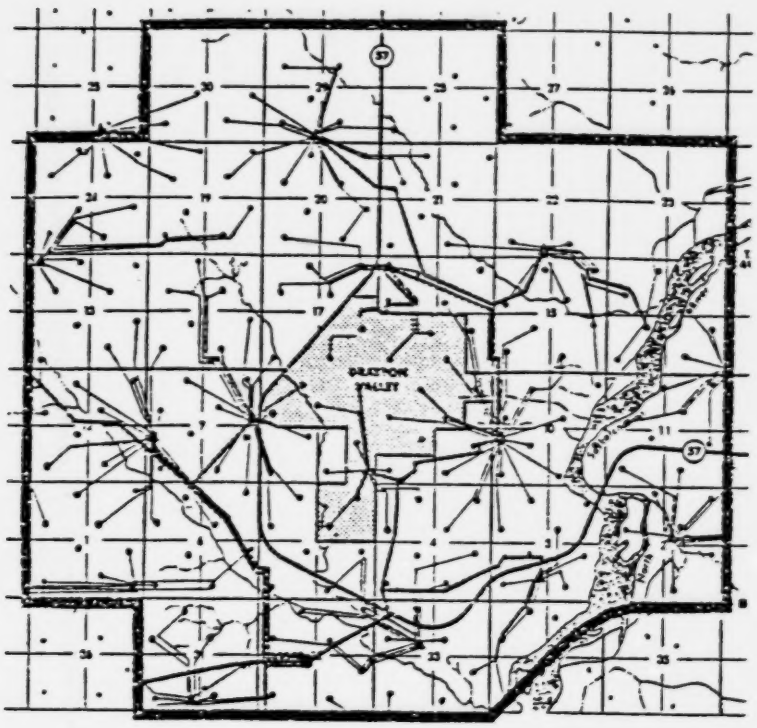


Figure 3. COMMUNITY DEVELOPMENT IMPEDED BY OIL COLLECTION SYSTEM (WELLS AND FLOW LINES)

5. OPPORTUNITIES FOR PROBLEM RESOLUTION

5.1 Conceptual Aspects of the Solution

5.1.1 The causes of the pipeline-urban encroachment problem are many. The foregoing analysis indicates that it arises at different geographic (spatial) scales and develops at all stages in the building of a pipeline and the subsequent growth of an encroaching urban environment.

Figure 2 sketches out in summary matrix form how the problem developed, noting actions taken or not taken at different time phases, and related these to the various spatial scales.

5.1.2 To add to the complexity, there are a variety of agencies, governments and groups of people involved in creating the problem, or at least in allowing it to occur.

A solution to the problem must, therefore, take into account this complex, interacting system and must offer specific measures to deal with spatial, time- and jurisdiction-related aspects of the problem.

5.1.3 Figure 4 illustrates that there is an equivalent set of solutions to match the various aspects of the problem laid out in the "problem matrix" of Figure 2, with specific measures attributable to the major groups of actors -- to private sector (pipeline companies, developers, etc.), local government (municipalities, RPCs, etc.) and Provincial government agencies (APB, DMA, ERCB).

5.1.4 In the analysis of potential solutions below, we concentrate most effort on examining how local, regional and Provincial governments or agencies can utilize land use planning instruments to contribute to a resolution of the problem.

Undoubtedly, our brief exploration of how the pipeline-related agencies and groups could contribute to a solution will be found to have shortcomings and inadequacies. We hope that the consultative process we propose will offer opportunities to correct these failings, which have occurred through the lack of expertise of the authors in this area rather than through any belief that all or even most of the solutions lie with land use planners alone.

Figure 4

CONCEPTUAL ASPECTS OF THE SOLUTION:
OPPORTUNITIES FOR PROBLEM RESOLUTION
AT DIFFERENT SPATIAL SCALES BY VARIOUS JURISDICTIONS

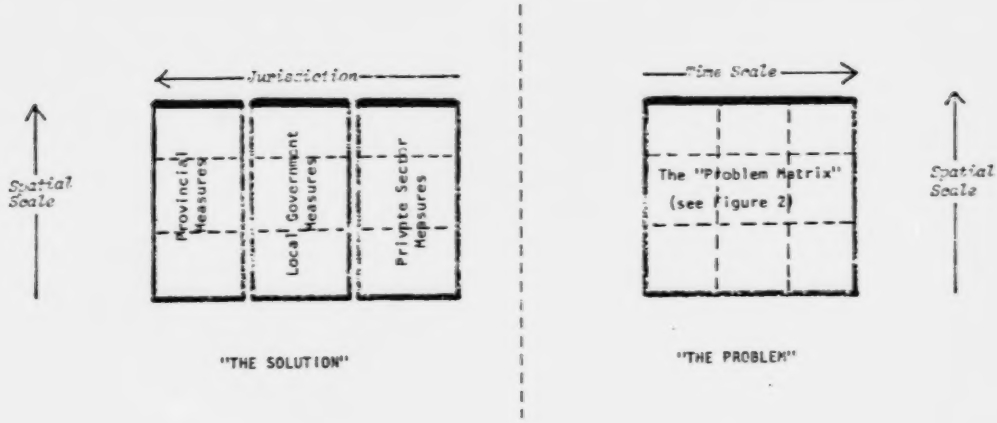
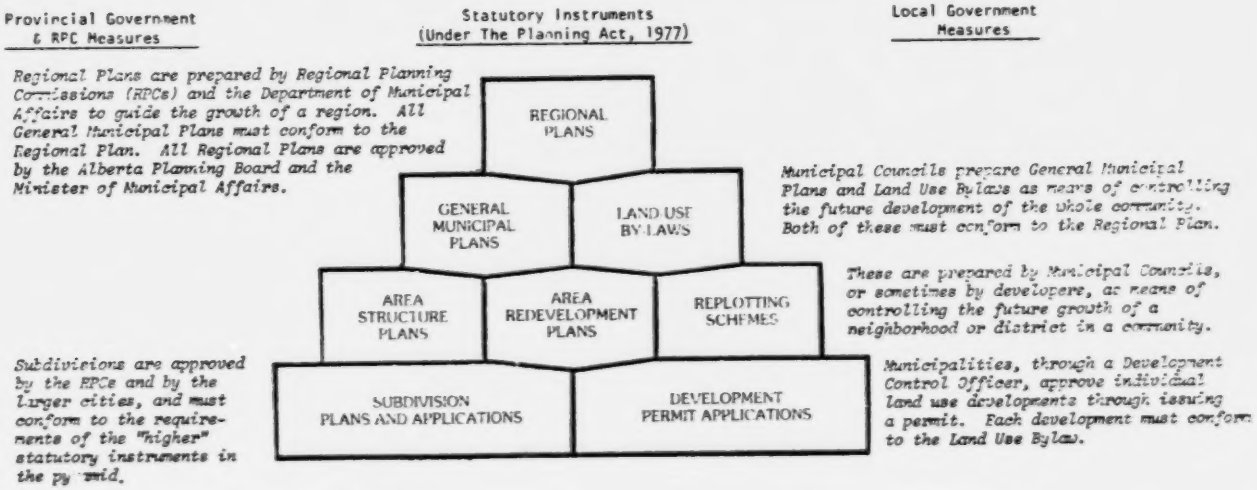


Figure 5

LAND USE PLANNING MEASURES FOR
RESOLVING THE PROBLEM


Provincial Government & RPC Measures
Statutory Instruments (Under The Planning Act, 1977)
Local Government Measures
Regional Plans are prepared by Regional Planning Commissions (RPCs) and the Department of Municipal Affairs to guide the growth of a region. All General Municipal Plans must conform to the Regional Plan. All Regional Plans are approved by the Alberta Planning Board and the Minister of Municipal Affairs.
REGIONAL PLANS
GENERAL MUNICIPAL PLANS
LAND USE BY-LAWS
Municipal Councils prepare General Municipal Plans and Land Use Bylaws as means of controlling the future development of the whole community. Both of these must conform to the Regional Plan.
AREA STRUCTURE PLANS
AREA REDEVELOPMENT PLANS
REPLOTTING SCHEMES
These are prepared by Municipal Councils, or sometimes by developers, as means of controlling the future growth of a neighborhood or district in a community.
Subdivisions are approved by the RPCs and by the larger cities, and must conform to the requirements of the "higher" statutory instruments in the pyramid.
SUBDIVISION PLANS AND APPLICATIONS
DEVELOPMENT PERMIT APPLICATIONS
Municipalities, through a Development Control Officer, approve individual land use developments through issuing a permit. Each development must conform to the Land Use Bylaw.

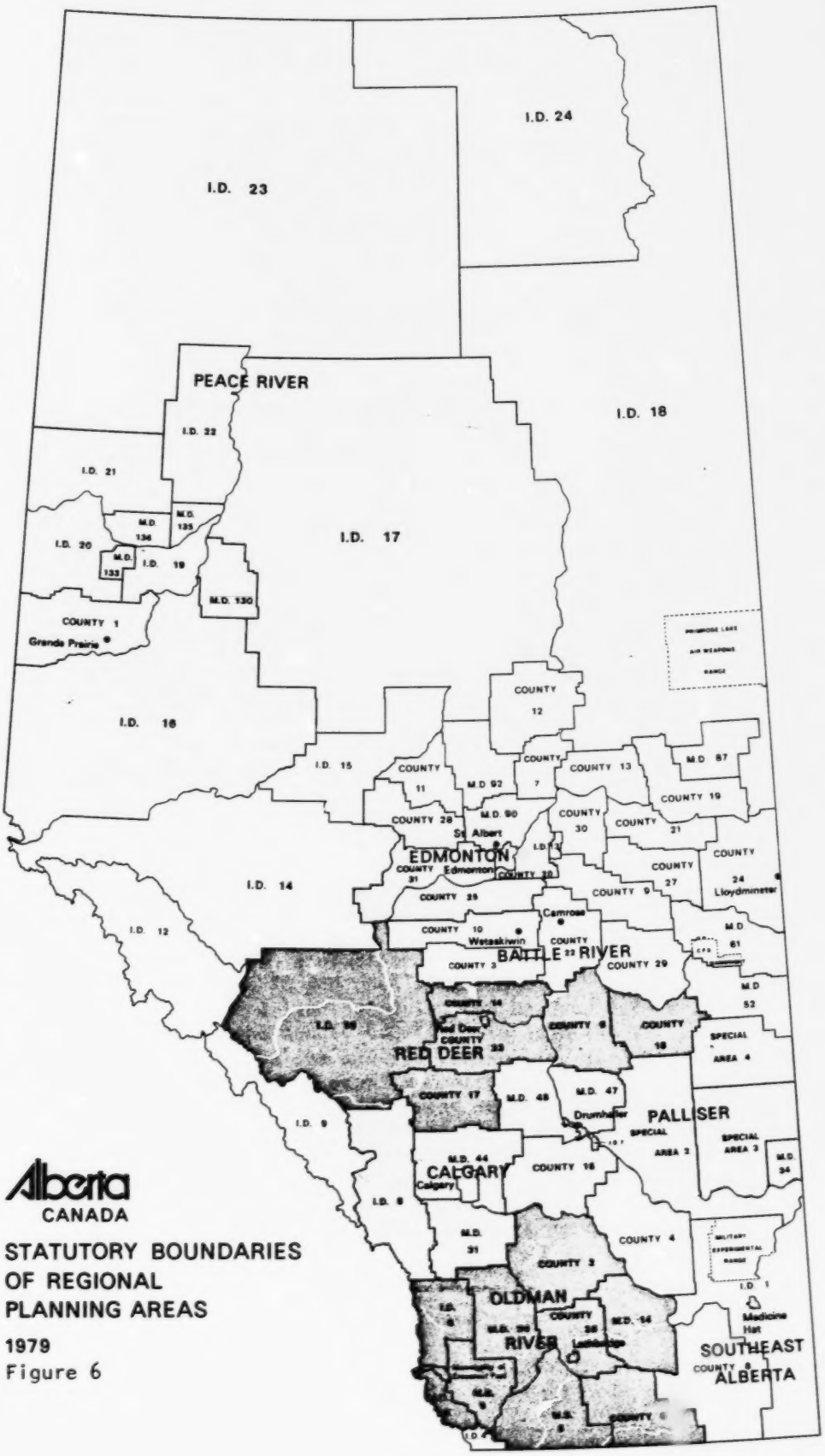
5.2 Through Land Use Planning Mechanisms

5.2.1 A number of opportunities exist to effect a solution to the pipeline-urban encroachment problem through the use of appropriate land use planning mechanisms. The Planning Act, 1977 provides for a hierarchy of statutory planning instruments, namely: the Regional Plan, the General Municipal Plan, the Area Structure Redevelopment Plan and Land Use Bylaw, which can be used to guide the subdivision and development of land at the regional and municipal levels (Figure 5). In order to understand how these instruments may be used to address the encroachment problem, it will be necessary to distinguish their respective functions and relationships.

5.2.2 The Regional Plan: At the top of the hierarchy resides the Regional Plan, which attempts to provide for the best and most orderly economic use of land on a regional scale. The plan is prepared taking into account the physical environment of an area, natural resources, present land use, population growth or decline, potential areas of land use conflict and demand by different types or development for new land. As such, it also sets a framework within which local municipal planning can occur. The Planning Act, 1977 in fact requires that every municipal statutory plan and instrument conform with the Regional Plan.

5.2.3 The preparation, adoption and implementation of the Regional Plan remains the responsibility of a regional planning commission, which is composed of all the municipalities in the region. There are eight such regional planning bodies in Alberta (Figure 6). In most cases, the regional planning commission is also the Subdivision Approving Authority for the entire region; however, such authority is sometimes also given to a municipality, such as the City of Edmonton and the City of Calgary.

5.2.4 As a final point, it should be noted that the Regional Plan must be approved by the Alberta Planning Board (APB) and ratified by the Minister of Municipal Affairs before it can become a formal legally valid planning instrument. Because of their role in the review, approval and ratification of the Regional Plan, the APB and the Minister of Municipal Affairs have significant influence on



Alberta
CANADA

STATUTORY BOUNDARIES OF REGIONAL PLANNING AREAS

1979

Figure 6

planning at the policy level. For instance, the Board recently adopted a set of guidelines specifying the general principles to follow in preparing the Regional Plan; the scope of the plan; and the Board's Regional Plan review process.

5.2.5 The General Municipal Plan: Similar to the Regional Plan, the principal function of the GMP is to foster orderly and efficient land use development in a municipality. It sets out the long term development goals, objectives and policies of the municipality, taking into account the municipality's social, economic and environmental needs, as well as identifies where growth is to occur within the municipality.

5.2.6 Area Structure/Redevelopment Plans: These may be considered a secondary municipal planning document, whose role is to shape the pattern of land development at the neighbourhood level. They are prepared by a developer, municipality or planning authority to indicate the general proposed land use for sectors of a municipality showing development/redevelopment potential.

5.2.7 The Land Use Bylaw: The LUB is an instrument used for regulating the size and use of land and buildings within a municipality, and may include detailed provisions pertaining to matters such as: minimum and maximum lot areas, floor areas of buildings, building setback from property lines, location of fences, off-street parking, billboard placement, density of population, and so on.

5.2.8 Frequently, the above provisions become the basis for subdivision and development control at the municipal and regional levels. Approval with or without conditions attached is required from the regulatory agencies (i.e. the municipal planning commission or the regional planning commission) in either cases before the subdivision or development of land is allowed. Thus, through careful enforcement of a Land Use Bylaw, many goals and policies contained in a General Municipal Plan can be implemented and land use conflicts can be reduced.

5.3 How Statutory Planning Instruments may be Applied to the Pipeline-Urban Encroachment Problem

5.3.1 The above instruments can be applied in a variety of ways. They may be used in an anticipatory manner to head-off or alleviate the potential problems of encroachment of urban development on a pipeline or vice versa, or they may be used to keep such problems under control after they have developed. Which instrument to apply will very much depend on the scope, nature and level of detail of problems to be addressed: in general

upon consultation with the ERCB and the pipeline operators, the Regional Plan can be used for setting planning priorities regarding the identification and designation of potential regional pipeline/utility corridors having regard to the technical and economic feasibility and limitations of this option; or for setting out general subdivision policies to bind other planning instruments to deal with the encroachment problem;

the General Municipal Plan can be used by the pipeline operator in selecting a pipeline route, or for identifying and designating joint pipeline ROWs based upon a consideration of the future population growth and direction of urban expansion of the municipality, as well as other technical and design considerations related to the routing and installation of the pipeline itself;

the Area Structure/Redevelopment Plan can contain detailed design criteria for integrating a pipeline with low density use such as parks and open space; and

the Land Use Bylaw can be used for regulating the subdivision of land adjacent to the pipeline and for controlling surface activities through density control, the imposition of minimum development setback conditions, and the requirement of the contractor to submit a detailed proposal on what care should be taken in performing any construction activities on, under or near pipelines as a condition for issuing a development permit.

5.3.2 The potential also exists for improving the level of consultation and communication between the planning agency and the ERCB through the subdivision referral process and the development of mutually acceptable setback standards, buffers etc. Improvements can be achieved if, for instance, in the Board's comments on subdivision applications, more details were given on the safety implications and emergency measures for the adjacent pipeline, and a tentative recommendation made as to the development setback requirement to minimize the potential impacts of a failure of the pipeline and so on.

5.3.3 Figure 7 summarizes how the various potential planning solutions relate to the original "problem matrix", and also indicates the major actions required by the Provincial government agencies to resolve the problems occurring at different geographic scales.

5.4 Complementary Actions Required by Various Agencies

5.4.1 The successful use of the potential afforded by the land use planning instrument is dependent, however, upon supportive and complementary actions being taken by agencies other than the land use planners and municipal officials.

5.4.2 These actions would include -- but not be restricted to -- the following summary points organized by the agency most affected.

The Alberta Planning Board

the development of Provincial guidelines requiring Regional Plans and other statutory planning instruments to recognize the problem and respond to it, and the amendment of The Planning Act, 1977 and Regulations where required.

The ERCB

the encouragement of pipeliners to cooperate with municipal governments in designating common rights-of-way; and in taking land use planning and future community growth as a factor in developing a pipeline project;

Figure 7

SUMMARY OF GOVERNMENTAL MEASURES FOR RESOLVING THE PIPELINE-URBAN ENCROACHMENT PROBLEM

Actions Required by Governmental Bodies		Use Of Planning Instruments to Resolve the "Problem Matrix": Content of the Various Plans, Land Use Bylaws Etc		
Provincial Measures	Local & Regional Measures	Planning Stage (Routing & Design of Pipeline)	Pipeline Installation/ Pre-urban Dev't. Stage	Urban Development Stage
. Prepare Pipeline ROW's policy guidelines (ERCB and APB) . Develop Criteria/Policy for relocation/upgrading of pipelines (ERCB) . Prepare Guidelines requiring the Regional Plan and General Municipal Plan to address pipeline issues (APB) . Develop a Policy on Consultation between pipeline operators and municipal/regional planning authorities	Regional Plan (Regional Planning Commissions)	. Identification of regional pipeline routes/corridors . Mechanism for monitoring the economic and environmental impacts of major pipeline projects . Setting General Subdivision Policies on land use in the vicinity of pipelines	. Monitoring potential conflicts between pipeline projects and urban growth	. Monitoring evolving relationships/conflicts between pipelines & urban growth . Recommending upgrading, or relocation of pipelines . Identification of alternative routes if relocation of pipelines is required
	General Municipal Plan (Municipal Councils)	. Designation of pipeline ROW's . Integration of pipeline ROW's with urban land use, based on a consideration of broad land use planning principles and timing of urban dev't. . Setting mechanisms for monitoring the impact of major pipelines projects on the municipality	. Monitoring potential conflicts between pipeline projects and urban growth	. same as above
. Develop design modules for integration of pipelines routes with urban land use (APB/ERCB)	Area Structure/Redevelopment Plan (Municipal Councils or Developers)	. Such a plan may or may not be required at this stage; however, it is desirable to commence preparation of such a plan to lay down general requirements for landscaping, buffer zones, etc.	. Design for integration of the pipeline with adjoining land use at site specific level, including - land uses permitted - landscaping and buffer zones - crossings of roads and utilities	. Monitoring if construction adheres to plan provisions/standards
. Spell out referral system for subdivision and development control . Initiate a training program for Development Control Officers	Subdivision and Development Controls, in reference to above statutory plans and the Land Use Bylaw. (by Subdivision Approving Authority/ Development Officers)	. Setting rules and land use design standards (e.g. landscaping buffer zones, permitted uses) for reference purposes in planning pipeline projects	. Imposition of development conditions on proposed developments in the vicinity of pipelines . Surveillance of construction activities (e.g. crossings by roalds and utilities) occurring on or near pipeline ROWs' through issuing development permits and site inspection	. Imposition of special safety provisions (e.g. setbacks, warnings on titles, buffer zones fencing) as conditions of approval of subdivision . Imposition of special precautionary measures as conditions of approval to development proposals or construction projects (through issuance of development permits . Surveillance and site inspection of construction activities on or near pipeline ROW's

the institution of a requirement, that land use development issues and the growth projections of municipal governments be criteria in the approval of pipeline projects;

the broadening of criteria for holding the public hearings into pipeline projects so as to widen the scope of representation before the Board;

(Needless to say, the above actions should still be applied on a selective, or need basis in order not to cause unnecessary delays to projects)

the strengthening of its information referral system (the "one call" procedure) to assist planners in locating potentially hazardous pipelines;

the distributing of maps and related information on pipeline location, design, products carried etc., to the subdivision approving authorities across the Province;

the exploration of a policy with the pipeline operators that aims at requiring the compulsory purchase of pipeline ROWs by the latter as a means for exclusive control over access to the surface activities on the pipeline ROW, and the installation of permanent fencing where there is absolute need (e.g. where a pipeline carries hazardous products through a densely populated area);

upon request to the Board the requirement of companies to relocate and/or upgrade of pipelines where they adversely affect or unreasonably endanger adjoining areas where there is a demonstrated need;

the requirement for deeper burial as a means of minimizing potential disturbance of the pipeline by the crossing of a large number of utility lines on a site specific or selective basis; and

the clarification of the obligations, rights and responsibilities of the pipeline operator, the land owner of a pipeline easement and the third party (i.e. the developer, the contractor, the public at large) with respect to ensuring the safety and integrity of the pipelines.

Joint ERCB/DMA or APB

the development of a referral system for the screening of subdivision applications, in the case of the most hazardous potential impact situations (to be operationalized between the subdivision approval authorities and the ERCB, pursuant to new Subdivision Regulations); and

the initiation of an education program for municipal officials, planners and development officers through seminars and training programs organized by ERGB/DMA, informing them of the hazards of encroachment, site inspection, etc. and the dissemination of information.

Pipeline Companies

the implementation of a public information program to inform neighbouring land owners, local construction firms and developers, and others of the location and hazards of pipelines;

the development of a municipal liaison/-land use planning capability so as to establish a continuing relationship with planners, development control officers and municipal officials, for those communities through which the more hazardous products pipelines pass; and

the development of a cooperative role -- with government agencies -- in the establishment of a "one call" or similar procedure.

Municipalities

the development of an awareness of the need to be involved in pipeline hearings and to gauge the impact of growth policies on proposed ROW locations; and

the development of policy requiring municipal Development Control Officers and building inspectors to regularly inspect at least hazardous products pipeline ROWs, as part of their routine inspection activities.

Developers and Contractors

the recognition of the necessity to take special design measures in their developments in order to accommodate pipelines while reducing the potential for third party damage to the pipelines;

the recognition of the need, in limited cases, for more stringent land use measures, such as minimum setbacks, fencing of ROWs, and so on; and

the recognition of the need for special precautions during the construction of utilities and buildings close to ROWS.

6. DESIGNING SOLUTIONS: THE ROLE OF GOVERNMENTAL AGENCIES

6.1 Since the private sector participants in the system are generally competitive and lack the mandate for arriving at a comprehensive approach to resolving the problem, most of the responsibility for designing a solution lies with government. Hence this section focuses on the role to be played by the major Provincial and local governmental agencies, in developing legislation, designing programs, and encouraging and facilitating action by the private sector and other actors.

6.2 It should be pointed out that some of the recommendations have already been implemented or are being considered for implementation. For example, it is learned a one-call procedure is now under consideration by the pipeline operators, the utilities companies and the ERCB. The Board is also in the process of amending the Pipeline Act to clarify some of the interpretation problems, and it has introduced a directive encouraging the joint use of pipeline ROWs.

The City of Edmonton, in addition to tightening up its procedures for site inspection and monitoring of construction activities occurring on or near pipeline ROWs, is also actively pursuing the option of introducing minimum development setbacks and other conditions as a means of regulating land development activities and controlling potential third party damage to the pipeline.

The Edmonton Regional Planning Commission has also joined in this effort by the inclusion of policies in its draft Regional Plan to deal with the subdivision of land near pipelines and powerlines.

6.3 The detailed recommendations which follow are in the form of a commitment package, which articulates the recommendations in such a way as to allow the users of this report to identify what immediate actions can and should be initiated; what further explorations should be made; who should be responsible for their implementation; and so on.

The commitment package is, therefore, viewed as a coherant action framework, developed by examining the necessary actions required of each agency or actor, and structuring them in terms of the following criteria:

> importance: which recommendations are keyed to resolving the pipeline-urban encroachment problem;
> urgency: which issues are the most urgent to solve first;
> payoff: which problems offer the best prospects for successful resolution and the greatest potential payoff?
> inter-relatedness: given that the problems and issues are not all independent of one another, does it make sense to group a subset of them for a joint approach?

6.4 However, the recommendations presented in the commitment package below should not be viewed as definitive, as they are intended to stimulate discussion with the appropriate agencies (e.g. Alberta Planning Board, Energy Resources Conservation Board, Regional Planning Commissions and Municipalities, Urban Development Institute, and Housing and Urban Development Association of Canada), before they are finalized.

6.5 It is important to observe, therefore, that the recommendations in the commitment package emphasize both the *content* and *process* aspects of land use planning, and tend to avoid suggesting rigid standards to which the planning of pipelines and the subdivision and development of land in the vicinity of pipelines must adhere. A case in point is the use of development setbacks which, in the overall context of the recommendations, are only regarded as complementary measures for reducing potential third party damage to the pipeline, and therefore, should be applied selectively to those urban areas affected by pipelines carrying hazardous products or operating under very high pressures.

7. DETAILED RECOMMENDATIONS: A COMMITMENT PACKAGE FOR GOVERNMENTAL AGENCIES

7.1 Recommendations for the Energy Resources Conservation Board as Lead Agency*

7.1.1 Recommendations for Action

1. Establish a mechanism for disseminating information re pipeline location, design products carried, etc. for municipal, regional and provincial planning agencies.

2. Establish a one-call procedure as a requirement to aid contractors doing any excavation activities near pipelines.**

3. Promote the initiation of a public education program designed and undertaken by the industry through audio-visual aids; and special programs to promote development officers', planners' and contractors' understanding of safety implications of pipelines.

4. Require pipeline companies to involve municipal government in the formulation of emergency contingency plans for proposed pipeline projects where required.

5. Amend pipeline legislation to empower pipeline operators to exercise stricter control of crossings by roads and other utilities.**

6. Initiate a policy to discourage pipelines from fragmenting land, or from locating in areas subject to urban development pressure. Such a policy may include the following elements:
   a) encourage joint use cf ROWs; establishment or regional utility corridors;

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*While other participants will have a role, *lead agency* implies a responsibility for leadership and initiating the actions necessary to facilitate a joint solution.

**It is learned that both recommendations have been or are being implemented.

b) mandatory municipal input in the Board's review and approval process for pipelines, on a selective basis in accordance with some pre-determined criteria; and

c) demonstration that municipal concerns are adequately addressed.

7.1.2 Recommendations for Further Exploration

1. Develop criteria for classification of various categories of pipelines, based upon measurable land use planning criteria and emergency responses.

2. Develop a pipeline ROW policy that may seek to:
   a) clarify the responsibility of the land-owner and pipeline operator for enforcement of easement agreement;
   b) require pipeline companies to purchase ROW where pipelines traverse densely populated areas, as a means of gaining complete control over surface activities;
   c) develop criteria for purchase of ROWs, with a view to eventual resale for development, with recoupment of original costs;
   d) encourage, where practicable, the integration of pipeline ROW with low-density uses (e.g. parks and open space), which does not necessitate purchase of ROW by the pipeline company but may require management fee payable to municipality;
   e) require the upgrading of existing pipelines, especially where they adversely impact urban development (e.g. aligning within densely populated areas).

3. Examine and establish criteria for relocation, where the integrity of the pipeline is adversely affected by adjoining development, or vice versa.

4. Explore the potential and cost implications of deeper burial of pipelines in urban areas as a means for reducing potential third-party damage by utility lines crossing over or under pipelines. Figure 8 illustrates some aspects of this problem.

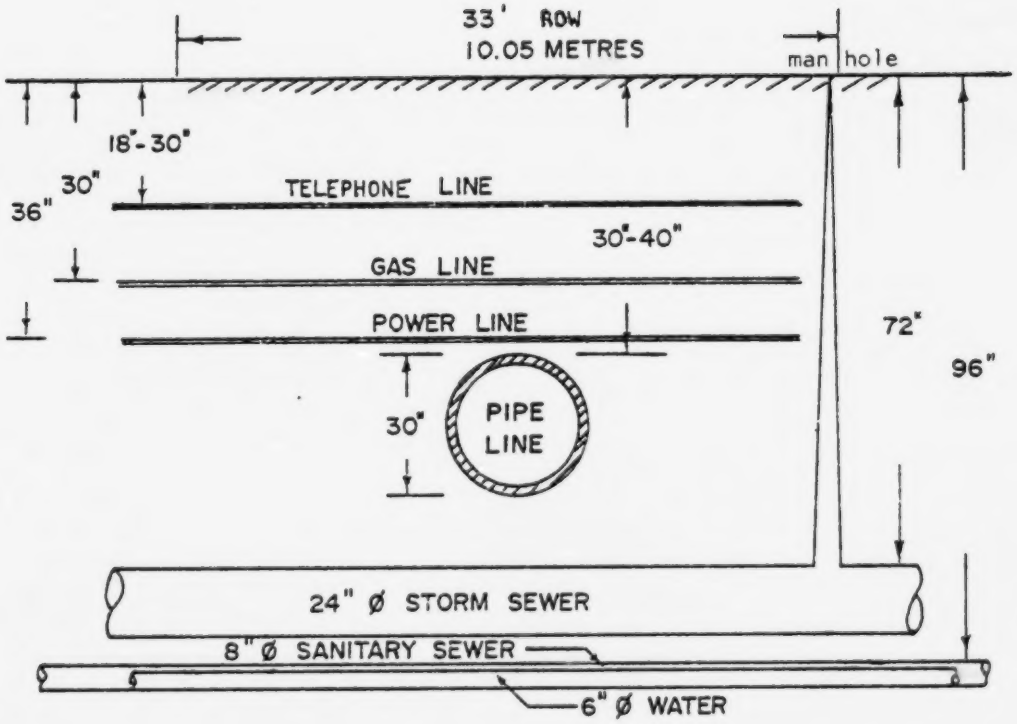

Figure 8. THE DEPTH OF BURIAL OF UTILITY LINES RELATIVE TO A GAS PIPELINE

7.1.3 Recommendations for Delayed Action

1. Pending availability of relocation criteria, collaborate with DMA and APB to set-up criteria and methods for apportioning the costs of relocation.

2. Explore expanding ERCB's in-house capacity for rendering land use related planning advice, and for monitoring, with the assistance of municipal and regional planning agencies, the evolving relationship of existing pipelines to adjoining developments for prompt intervention.

7.2 Recommendations for the Department of Municipal Affairs and the Alberta Planning Board as Lead Agencies

7.2.1 Recommendations for Action

1. Develop policy guidelines encouraging the designation of regional and municipal transportation utility corridors in regional plans and general municipal plans.

2. Amend the Planning Act to prohibit the location and construction of residential lots on pipeline ROWs. (i.e. to maintain a clear visible pipeline ROW).

3. Develop special education/training programs for development officers, planners and municipal officials through the assistance of the ERCB.

7.2.2 Recommendations for Further Exploration

1. Collaborate with ERCB in the development of a set of criteria, and a process to assist municipalities in imposing discretionary development setback conditions, in areas impacted by pipelines.

   Figure 9 sets out a conceptual schema examining the use of setbacks and other land use development measures based on an assessment of the potential impact on a neighbouring urban community should pipelines carrying various petrochemicals fail.

Figure 9

SELECTIVE USE OF PREVENTIVE MEASURES BASED
ON POTENTIAL IMPACT OF FAILURE OF VARIOUS TYPES OF PIPELINE
(A CONCEPUTAL SCHEMA)

Categories of Potential Impact		Affecting Mainly Pipeline Industry & Regulatory Agency			Affecting Mainly Development Industry, Planners & Regulatory Agencies				
		Relocation	Deeper Burial of Pipelines	Surveillance	Control over Construction Activities	Compulsory Referral of Subdivision & Development Applications	Warnings on Title	Development Setback	Other Conditions (e.g. compulsory purchase of pipeline ROWs)
HIGH IMPACT (e.g.sour gas/ propane pipeline)	1	Yes	Yes	Freguent & regular (e.g.daily)	Yes, with special conditions	Yes	Yes	Yes	Yes
	2	No	Yes	regular (weekly)	Yes, with special conditions	Perhaps	No	Yes/No	No
	3	No	No	regular (monthly)	Yes	No	No	No	No
LOW POTENTIAL IMPACT (e.g. oil pipeline)	4	No	No	half-yearly	Yes	No	No	No	No

The approach suggests that a graded response is necessary, depending on the severity of potential impact and that, therefore, setbacks, fencing, compulsory purchase and so on should only be utilized in the case of the most potentially hazardous situation.

2. Explore amending the planning legislation empowering municipal agencies to require a contractor contemplating any work on or near a pipeline ROW to:
   a) file a plan detailing the method and precautionary measures for carrying out such works;
   b) develop a special bond to further ensure the safety of the pipeline, as a condition of issuing a development/building permit.

3. Explore initiating a "warning on title" system to keep residents living close to pipelines aware of the existence of and the safety implications of pipelines carrying hazardous products.

4. Investigate the feasibility of the use of bonus zoning or transferrable development rights as a means for compensating the developer and reducing the cost of development in areas requiring the imposition of development setback conditions.

7.2.3 Recommendations for Delayed Actions

1. Initiate a project to prepare design modules for integration of the pipelines with adjoining land uses, as a guide for developers and planners in designing new development; and for pipeline companies in planning their ROW acquistions.

7.3 Recommendations for the Regional Planning Agencies and Municipalities as Lead Agencies

7.3.1 Recommendations for Action

1. Include regional pipeline corridors as an element in regional plans and general municipal plans.

2. Assist ERCB and pipeline operators in determining potential routes for pipelines, what would cause minimum fragmentation of land, and avoid or reduce future urban encroachment problems, etc.

3. Encourage, where practicable, integration of pipelines with low-density land use, through area structure plans;

4. Tighten surveillance and inspection over construction-related activities on or near pipeline ROWs; requirement of development permits for such work, etc.;

5. Acquire from ERCB, region information on pipeline location/routes, products carried, emergency plans, safety implications, etc., and

6. Participate in public hearings with a view to protecting future urban developments from potentially hazardous situations.

7.3.2 Recommendations for Further Exploration

1. Explore the feasibility of requiring Development Control Officers, building inspectors or other municipal officials to regularly monitor construction and other activities in proximity to the more potentially hazardous pipelines.

7.3.3 Recommendations for Delayed Action

1. Subject to the findings of 7.2.2.2 above prepare and/or amend land use bylaws that enable the municipality to require contractors to file methods and precautionary measures for carrying out work on or near a pipeline ROW; and

2. Subject to 7.2.2.3 above, institute a "warnings on title" system, in cooperation with the RPC.

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The purpose of this bibliography is to list on a selective basis the main sources of reference used in the report, and hence is not meant to be comprehensive or exhaustive.

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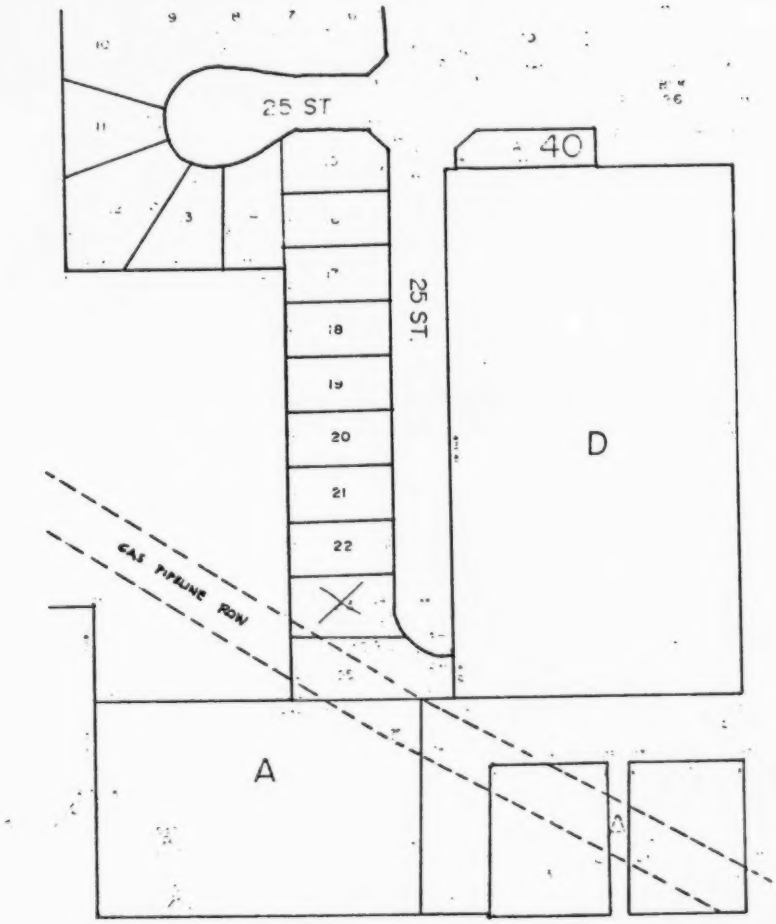
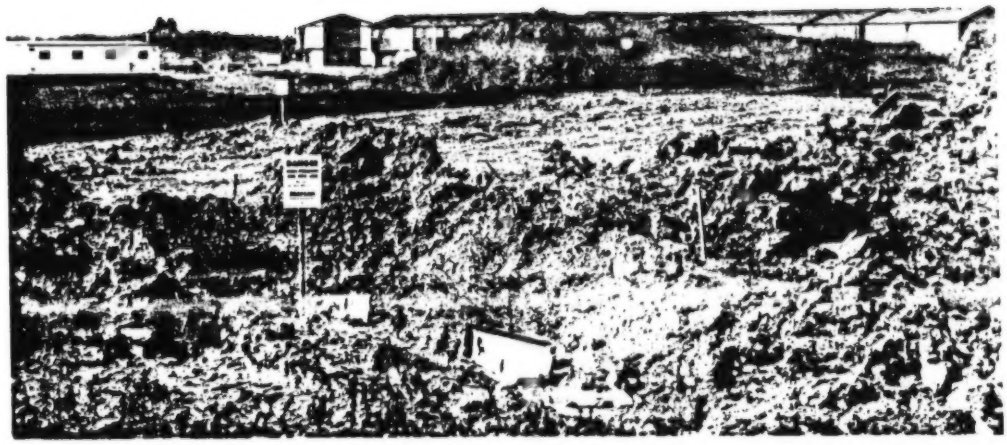


PLATE 1a) URBAN SUBDIVISION ENCROACHING ON ESTABLISHED GAS PIPELINE ROW

PLATE 1b) URBAN ENCROACHMENT: FOOTING FOR RESIDENTIAL BASEMENT LIES NEXT TO PIPELINE ROW



PLATES 2 & 3: RESIDENTIAL SUBDIVISION ENCROACHING ON ESTABLISHED GAS PIPELINE ROW

PLATE 4: A "PLANNED SUBDIVISION", SHOWING PROXIMTY OF TOWNHOUSES TO GAS PIPELINE ROW

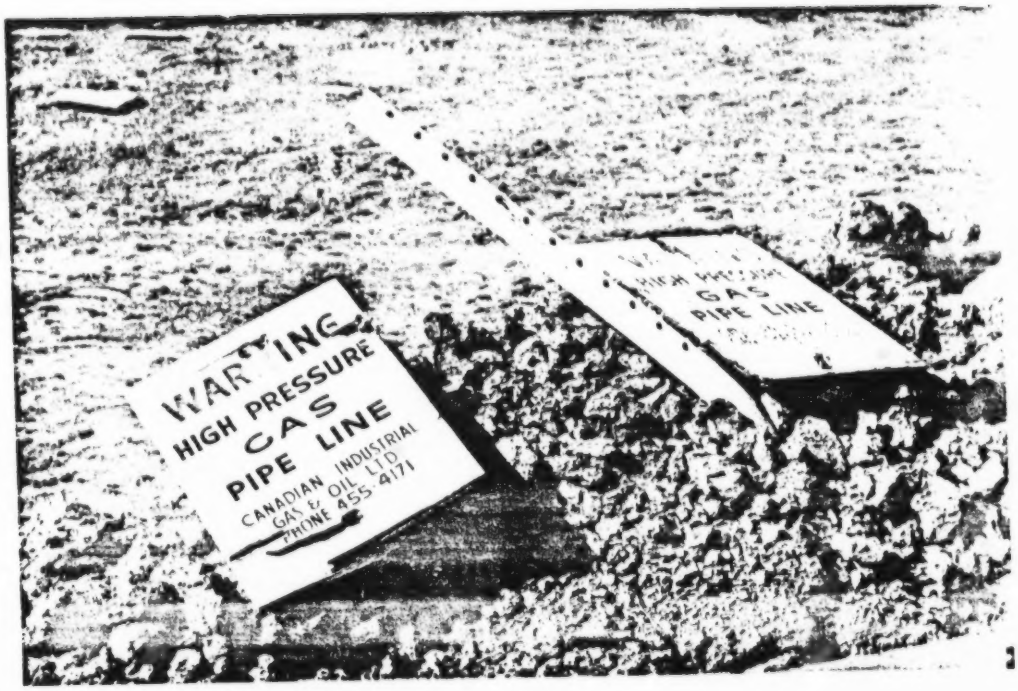


PLATE 5: URBAN CONSTRUCTION ACTIVITY MAY DESTROY EVIDENCE OF THE EXISTENCE OF A PIPELINE